OMNO2 Release Notes

Document Version 2.0: February 2008
Data Product Version 1.0.5

These Release Notes describe changes that have been made to the OMI NO_2 data set, OMNO2. Only changes made since the provisional release (2005-11-21) are listed.

Version 1.0.5 (Collection 3), Released 2007.11.09

In this release, changes have only been made to the Level 1B processing (GDPS) and PGE-A (OMNO2A). The Collection 3 Level 1B data have significant improvements over the previous version, leading to better quality fit results. The striping seen in Version 1.0.0, even after a "destriping" algorithm was applied, has been greatly reduced due to an improved dark current correction and improved QA flags. The DOAS fit residuals are much smaller, and the precision of the NO_2 slant column is in line with estimates from the instrument noise.

Specific changes to the Level 1B processing are detailed elsewhere. See the following references:

1 Dutch Space, "Ozone Monitoring Instrument for EOS-AURA: OMI GDPS Software User Manual," Document No. MA-OMIE-7000-DS-459, Issue 6, 5 October 2007.

2 M. Dobber, Q. Kleipool, R. Dirksen, P. Levelt, G. Jaross, S. Taylor, T. Kelly, L. Flynn, G. Leppelmeier and N. Rozemeijer, "Validation of Ozone Monitoring Instrument level-1b data products." *J. Geophys. Res.,* (in press).

Changes that have been made in the Level 1B to Level 2A processing are as follows:

1. The order of the polynomial that is used in the DOAS fit to remove the background has been increased from 3 to 5. Analyses have shown that this increase in polynomial order decreases the error in the NO_2 slant column density computed using a nonlinear fit.

2. The solar spectrum used to compute the Sun-normalized radiance in Version 1.0.5 is static. Version 1.0.0 had used a the daily measured solar spectrum. The static solar spectrum in version 1.0.5 is an average over all the daily Sun observations from OMI in the year 2005. Analyses have shown that using a static irradiance spectrum based on

many observations resulted in much smaller dark current related stripes.

3. In Version 1.0.5 a water vapor spectrum has been added to the set of basis functions used in the DOAS fit. Analyses have shown that the water vapor columns derived from the DOAS fit were physically meaningful, and improvedthe quality of the retrieved NO_2 slant columns. The same analyses showed that no physically meaningful O_4 were obtained, when the O_4 spectrum was included in the DOAS fit, and there was generally no improvement in the retrieved NO_2 columns. For that reason, O_4 is not included in the fit.

4. The reference cross sections of NO_2, O_3, O_4, H_2O and the Solar and Ring spectra have been updated, based on the latest version of the OMI on-ground measured slit functions. [Include a reference citation.] In addition, the water vapor spectrum has been updated to remove artifacts from the reference spectra.

5. Several smaller changes and bug-fixes have been implemented.

Version 1.0.0, Released 2006.09.08

Public Release

(1) Level-2 files now contain three main types of vertical column NO_2 and estimates of their uncertainties. These are the observed total column (*ColumnAmountNO2*), the observed tropospheric (*ColumnAmountNO2Trop*) column, and observed polluted column (*ColumnAmountNO2Polluted*). The fields for the unpolluted column (*ColumnAmountNO2Unpolluted*) and its uncertainty (*ColumnAmountNO2UnpollutedStd*) now contain only fill values. As before, the smooth field is defined by the Fourier coefficients, which are included in the file.

(2) The files also contain an estimate of the column amount hidden any clouds in the field of view (*ColumnAmountNO2BelowCloud*). This quantity – also called the “ghost column” - and its uncertainty are given for each OMI pixel with measurable pollution and a defined cloud fraction greater than zero. It is not a fixed quantity from a look-up table, but is computed from on the measured column amount and the *a priori* tropospheric profile shape. *ColumnAmountNO2BelowCloud* can be added to the total, tropospheric or polluted columns to obtain the respective complete columns, which are independent of cloud amount. However, the ghost column amount becomes less certain as the cloud fraction increases, particularly for cloud fractions > ~40%. Therefore, the

user should carefully consider cloud information when selecting data for use in validation studies or other investigations.

(3) A summary flag is now included with each observation to alert the user to the presence of one or more significant data quality issues.

(4) Cloudy and clear components of the AMFs (both polluted and unpolluted) are now defined relative to the above-ground vertical column (previously they were relative to the visible column and thus contained cloud fraction information). The values of the radiance-weighted sums of the clear and cloudy AMF components are unaffected by this change.

(5) Uncertainty calculations for all quantities have been improved since the provisional release. Air-mass factor uncertainties are now dependent on cloud parameters, terrain reflectivity and estimated a priori profile variability. In all calculations, cloud-fraction uncertainty is fixed at ± 0.05.

(6) The relationships among the column amounts and air mass factors in the current OMI algorithm are as follows:

$$A_u = w \cdot A_u^{cloudy} + (1-w) \cdot A_u^{clear}$$

$$A_p = w \cdot A_p^{cloudy} + (1-w) \cdot A_p^{clear}$$

$$A_p^{obs} = A_p \cdot (V_p / V_p^{obs}) \Big|_{a\ priori}$$

$$V_p^{obs} \Big|_{a\ priori} = f \cdot V_p^{above\ cloud} \Big|_{a\ priori} + (1-f) \cdot V_p \Big|_{a\ priori}$$

$$V_{init} = S / A_u$$

Unpolluted Case:

$$V = V_{init}$$

$$V_{trop} = V_{init} \cdot t$$

Polluted Case:

$$V_p^{obs} = (V_{init} - V_u) \cdot (A_u / A_p^{obs})$$

$$V_{trop}^{obs} = V_p^{obs} + V_u \cdot t$$

$$V^{obs} = V_p^{obs} + V_u$$

$$V_{strat} = V^{obs} - V_{trop}^{obs}$$

$$V_{ghost} = (V_{init} - V_u) \cdot (A_u) \cdot (1/A_p - 1/A_p^{obs})$$

$$V_p = V_p^{obs} + V_{ghost}$$

$$V_{trop} = V_{trop}^{obs} + V_{ghost}$$

$$V = V^{obs} + V_{ghost}$$

In the above expressions, *A* is an air mass factor, *V* is a vertical column amount, *S* is a slant column amount, *f* is the effective cloud fraction, *w* is the cloud radiance fraction and *t* is the tropospheric fraction of the unpolluted column (about 0.05). The subscripts are *p* for polluted, *u* for unpolluted and *init* for initial. The air mass factor superscripts are *clear* for clear-sky, and *cloudy* for overcast sky. The column superscripts are *above-cloud* (indicating integration from cloud top to infinity), and *obs* for the observed column (the column above cloud or ground that is visible to the satellite). Column amounts labeled *a priori*, were calculated by integrating an a priori NO_2 profile. V^{obs}, V_p^{obs} and V_{trop}^{obs} are retrieved observed column amounts, and V V_p, V_{trop} are the corresponding amounts above ground, computed by adding estimates of the below-cloud column to the visible column. V_u is the smooth unpolluted field from the planetary-wave analysis.

Version 0.9.1, Released 2006.05.15

(1) A bug was identified and fixed. The cloud reflectivity assumed when reading and interpolating the dAMF file was not consistent with the cloud reflectivity assumed in the Level-2A cloud parameters from the O2-O2 cloud algorithm.

Prior to this version, a cloud reflectivity of 85% had been used in the OMNO2B algorithm, rather than the value of 80% assumed in the O_2-O_2 cloud algorithm. A value of 80% is now assumed throughout the calculation. The effect of this change has not been quantified, but is expected to be minor.